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(54) **Metallic surface with projections filled with absorbent material**

(57) A device, particularly for use with infra-red calibration equipment for the measurement of temperatures by emission comparison with a surface maintained at a uniform, known temperature, has a metallic surface 1 on which is formed a matrix of projections 4, preferably pyramids, the spaces between the projections being filled with an absorbent material 5 e.g. silicon carbide, manganese oxide, tin oxide, or a refractory cement made from calcium aluminate and water. The metallic surface may be formed from stainless steel, copper or a copper alloy. The projections 4 may be 4 mm high and have a separation of 2 mm. The surface may be dimpled 6.

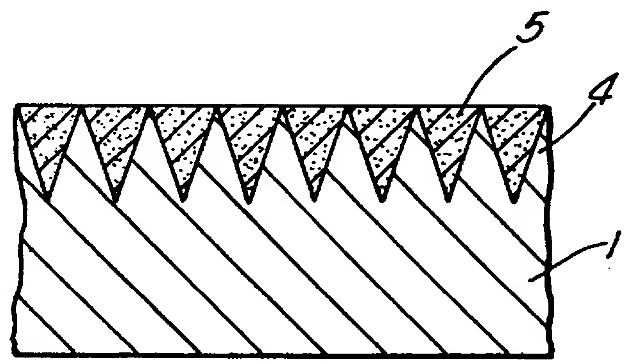

Fig. 2.

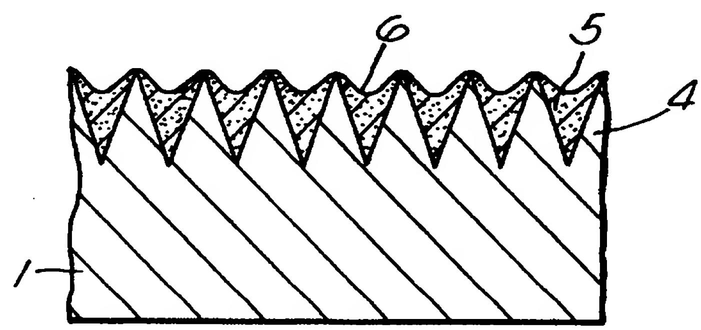

Fig. 3.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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Fig.1.

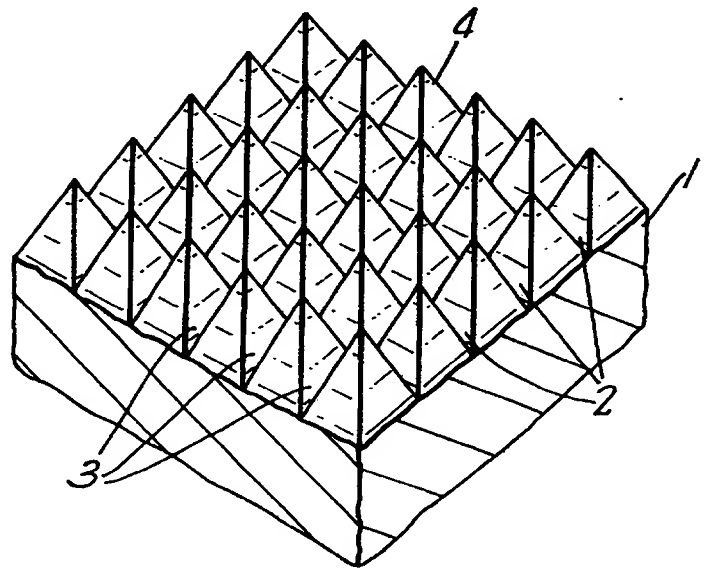


Fig.2.

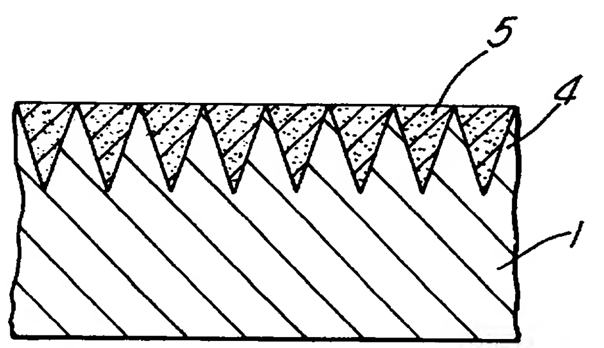
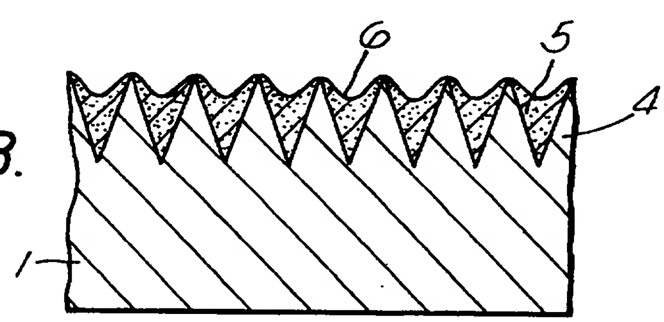


Fig.3.



SPECIFICATION

Surfaces having high absorption and emission values

This application relates to the production of surfaces having high emissivity and absorption, and therefore low reflectivity, at millimetre and infra-red wavelengths at high temperatures, and provides a construction which is robust and can withstand mechanical abrasion and temperatures in excess of 600°C. Such surfaces are used, for example, in infrared calibration equipment by means of which temperatures can be measured by emission comparison with a surface maintained at a uniform, known temperature.

The methods for producing blackened metallic surfaces at visible wavelengths are not applicable to longer wavelengths, since the thickness of the absorbing layer which has to be formed on the metal surface needs to be increased with increasing wavelength, and at millimetre wavelengths the conventional type of layer is either too thin to be effective or is otherwise mechanically fragile or has poor thermal contact with the underlying surface.

Good thermal conduct is necessary if the surface is to be used as a "hot source" for infra-red or millimetre wavelength calibration work, or if it is to be effective as a high power-density absorber of such radiation, and mechanical robustness is an advantage, and often essential, for all applications of such a surface.

This invention consists of a metallic surface having formed on it a matrix of projections, the spaces between the projections being filled with an absorbent material.

The projections may comprise rectangular pyramids, formed by machining two orthogonal series of V-grooves into the surface, but the series need not be orthogonal and any pyramid or cone is likely to be equally effective. The absorbent, filling material may comprise a lossy component such as silicon carbide, manganese oxide, tin oxide or other similar substances, mixed with a refractory cement, acting as a high temperature adhesive, such as a proprietary product or a standard formula such as calcium aluminate and water.

The optimum height and separation of the projections within the matrix depend on the wavelength of the radiation to be absorbed or emitted and the optical properties of the filling material. The refractive index and absorption coefficient of the material at these wavelengths must be optimised for best performance, and for typical values and radiation wavelengths in the 1mm to 3mm range, a projection height of 4mm and a separation in the matrix of 2mm will produce a surface with an emissivity in excess of 0.85.

For optimum performance, the filling material must have a high coefficient of absorption at the wavelengths being considered, values of 5 nepers per cm or greater being generally required, and it is preferable for the material to have a modest refractive index, values of 2.5 or less appearing to be best. The material must also be chosen to have as low a surface reflectivity as possible. To assess this, reflection measurements in the range 75–1500 GHz may be made using a Michelson interferometer and allowance for scattered reflections may be made using a stirred mode cavity, which distinguishes between true absorption and scatter of radiation.

Although the surface of the filling may be smoothed over across the apices of the projections, it may be for some applications advantageous to avoid a flat surface by producing a pattern in it. It has been found that by machining lines of shallow troughs or grooves in the surface between and parallel to both lines of pyramids, then if the depth of the troughs or grooves is of the order of one wavelength or less, the reflection of incident radiation from the surface is considerably reduced from the figure obtained for a smooth surface of the same material.

By way of example, embodiments of the invention will now be described with reference to the drawings, of which

Figure 1 is an oblique view of a metallic surface machined and ready for in-fill material to be applied, for use with radiation in the 1mm to 3mm wavelength range,

Figure 2 is a transverse section through a surface completed in accordance with the invention, and

Figure 3 is a similar transverse section illustrating a construction having a modified upper surface.

With reference to Fig. 1, a sheet of stainless steel 1 has machined into one surface two orthogonal series 2 and 3 of V-grooves, the separation of the groves being 2mm and their profile being such as to produce a matrix of rectangular pyramids 4 which are 4mm in height.

The space between the pyramids is filled completely (see Fig. 2) with an absorbent material 5, this being a mixture of a lossy component, silicon carbide, and a refractory cement.

In the alternative embodiment illustrated in Fig. 3, the materials and construction are similar except that the outer surface 6, instead of being smoothed over across the apexes of the pyramids, is of a dimpled form to break up further any reflections off the outer surface and to reduce the reflectivity as described above.

It will be obvious to those skilled in the art that profiles other than that illustrated Fig. 3 may be effective. If appropriate, manganese or tinoxide, or some other material, could be used instead of silicon carbide as the lossy component and any proprietary product or a

standard formula such as calcium aluminate and water could be used as the refractory cement, depending on the high temperature properties needed.

Rectangular pyramids are in many ways the easiest structures to produce in the metallic surface, but in principle there is no reason why other structures, such as triangular pyramids or cones, for example, should not be equally effective and this invention extends to these and similar structures.

For other applications, a highly conductive material such as copper or an alloy thereof may be used as the backing material 1; or at least the projections 4 may be constructed of such a material, if necessary along with the immediately adjacent layer of the backing material.

CLAIMS

What is claimed is:

1. A device having a metallic surface on which is formed a matrix of projections, the spaces between the projections being filled with absorbent material.

2. A device as claimed in Claim 1 wherein the projections are in the form of rectangular pyramids.

3. A device as claimed in Claim 2 wherein the pyramids are formed by machining two orthogonal series of V-grooves into the surface.

4. A device as claimed in Claim 1 wherein the projections are triangular pyramids.

5. A device as claimed in Claim 1 wherein the projections are cones.

6. A device as claimed in any one of Claims 1 to 5 wherein the projections have a height of substantially 4mm and a separation of substantially 2mm.

7. A device as claimed in any one of Claims 1 to 6 wherein the absorbent material contains a lossy substance.

8. A device as claimed in Claim wherein the lossy substance is silicon carbide manganese oxide, or tin oxide.

9. A device as claimed in Claim 7 or in Claim 8 wherein the substance is mixed with a refractory cement.

10. A device as claimed in Claim 9 wherein the refractory cement is made from calcium aluminate and water.

11. A device as claimed in any one of Claims 1 to 10 wherein the absorbent material is smoothed over the apices of the projections to give a flat surface.

12. A device as claimed in any one of Claims 1 to 10 wherein the absorbent material has a patterned surface.

13. A device as claimed in Claim 12 wherein the patterned surface is formed by machining an orthogonal series of lines of shallow troughs or grooves between and parallel to the projections.

14. A device as claimed in any one of Claims 1 to 13 wherein the absorbent material has a coefficient of absorption of the order of 5 repes per centimetre.

15. A device as claimed in any one of Claims 1 to 14 wherein the absorbent material has a refractive index of 2.5 or less.

16. A device as claimed in any one of Claim 1 to 15 formed from stainless steel, copper or an alloy of copper.

17. A device substantially as described herein with reference to Figs. 1 to 3 of the drawings.

18. Infra-red calibration equipment including a device as claimed in any one of Claims 1 to 17.

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